



Project Summary

Comparison of Methods to Determine Dislodgeable Residue Transfer from Floors

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Comparisons were made of the transfer of formulated pesticide residues from treated carpets and vinyl flooring by three dislodgeable residue methods and by human skin. The Dow drag sled and the Southwest Research Institute polyurethane foam (PUF) roller performed better than the California cloth roller. Moistening the sampling media increased the transfer by the drag sled and the PUF roller, but substantially increased measurement variability. An isopropanol handwipe method efficiently removed dried pesticide residues from the hands of volunteers (104% of chlorpyrifos, 92% of pyrethrin I). The transfer efficiency of the drag sled consistently exceeded the transfer efficiency of the PUF roller, which consistently exceeded the transfer efficiency of human hand presses. This relationship was observed for a variety of pesticides, loadings, application methods, and surfaces.

Both the drag sled and the PUF roller were found to be acceptable dislodgeable residue methods on the basis of these studies. The pliable polyurethane foam sampling surface of the PUF roller with its rolling action is likely to better simulate human skin in its pesticide transfer via contact with surfaces than is the denim cloth of the Dow sled with its drag action. Either mechanical method can be used to estimate dermal transfer of pesticide residues from recently treated floors. Round-robin testing of the drag sled and PUF roller by potential registrants is recommended under strict QA/QC guidance

from the U.S. Environmental Protection Agency (EPA). This report was submitted on Contract 68-DO-0007 by Southwest Research Institute under subcontract to Battelle under the sponsorship of the U.S. EPA. Work was conducted from July 1992 to September 1993 and the report was completed as of November 1995.

This Project Summary was developed by the National Exposure Research Laboratory's Air Measurements Research Division, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

After a pesticide application in a home, the residents may receive dermal exposure through direct contact with the treated surfaces. The exposure of young children after treatment of carpets and baseboards, both through direct skin contact and through mouthing of hands and objects, is a particular concern. The Dow drag sled, California cloth roller, and PUF roller are dislodgeable sampling methods which have recently been developed to estimate the transfer of a chemical from a contaminated surface to the skin. The objectives of this study were to compare the transfer rates of pesticides from treated flooring among these three methods and against transfer to a human hand; to determine the wipe removal efficiency of pesticides from hands by an isopropanol handwipe method; and to evaluate the effects of

carpet type, moistened sampling media, other sampling variables, and temperature on mechanical transfer.

Procedure

For the drag sled method, one pass was made over a 1-m strip of flooring by dragging a precleaned denim-weave cloth attached beneath foil under a (3 in)² plywood block on which an 8-lb weight was mounted to provide a contact pressure of 5900 Pa through the cloth. The California cloth roller method consisted of placing a precleaned (17 in)² percale cloth covered with plastic sheeting on the floor and making 20 rolling passes over it with a PUF-wrapped, capped 2 ft. x 4 in. diameter plastic pipe containing 25 lbs of shot, to provide a contact pressure of 2300 Pa through the cloth. For the PUF roller method, one pass was made over a 1-m strip of flooring by rolling a precleaned 3 in-long ring of PUF mounted on an aluminum cylinder, with two stainless steel blocks mounted on the instrument frame to provide a constant contact pressure of 8000 Pa through the PUF ring. For the hand press method, a subject made one pass over a cardstock-template-exposed 0.64 m x 3 in strip of flooring by pressing the soap-and-water-washed palm of one hand for 1 s at a pressure of about 1 psi (6900 Pa) onto each of ten adjoining sections of the strip. The subject wiped transferred residues from his hand using two isopropanol-moistened gauze sponges.

A series of experiments was performed to compare the transfer from carpet or vinyl flooring of recently-applied formulations of chlorpyrifos, natural pyrethrins, and piperonyl butoxide by these methods. A licensed pest control applicator treated the test flooring for each experiment according to label directions to control flea infestation. Adjacent deposition coupon and transfer samples for the compared methods were sequentially collected for each experiment, usually within each of six rectangular blocks of treated flooring. Field blanks of each transfer method were obtained by sampling prior to the applica-

tion. Field samples were collected from at least two blocks after label-permitted re-entry (>2 hr after application) on the day of application, and also on the next two days if human subjects performed hand presses. Field spikes of each precleaned transfer medium were performed both before and after the field sampling to assess losses during transport, storage, and extraction.

Results and Discussion

Mean transfer of chlorpyrifos from treated carpet onto the dry sampling media of the mechanical methods, when used as described by their developers, was largest for the California cloth roller, intermediate for the drag sled, and smallest for the PUF roller. This relation was observed for both plush nylon and level-loop polypropylene carpet. The California cloth roller was found to be less practical and more variable than the drag sled or PUF roller methods.

Transfers of chlorpyrifos from plush carpet onto water-moistened sampling media were larger than transfers onto dry media, for both the PUF roller and the drag sled. However, transfers onto water-moistened media were substantially more variable. Transfer sampling with water-moistened media was found to be impractical.

Both the drag sled and the PUF roller transferred an amount of formulated chlorpyrifos residue from plush carpet which was generally proportional to the length of carpet traversed. An essentially constant amount of chlorpyrifos appeared to transfer to the PUF roller on each of the first 20 passes over a 1-m strip of treated plush carpet.

Increasing the pressure applied by the drag sled to chlorpyrifos-treated plush carpet had little effect on chlorpyrifos transfer to the cloth sampling medium. In contrast, increasing the pressure applied through the PUF ring by the roller sampler produced a nearly proportional increase in chlorpyrifos transfer. As the carpet temperature increased, the drag sled and PUF roller both transferred slightly larger

amounts of both fresh and aged residues of several pesticides from plush carpet.

The isopropanol hand wipe method efficiently removed dry pesticide residues from the hands of two volunteer subjects within the first minute after their transfer from aluminum foil to the hand. Wipe removal efficiency was determined by mass balance after accounting for extraction and elution efficiency. The mean wipe removal efficiencies from hands were 104 % (s = 11%, n = 12) for formulated chlorpyrifos, and 92% (s = 28%, n = 12) for formulated pyrethrin I fortified with analytical standard.

The transfer efficiency of formulated pesticide residues from treated carpets and vinyl flooring was consistently highest for the drag sled, intermediate for the PUF roller, and lowest for human skin. In comparing transfers of formulated chlorpyrifos, pyrethrin I, piperonyl butoxide, and methoprene, the specific active ingredient had virtually no effect on transfer efficiency. However, transfers by each method were about an order of magnitude higher from sheet vinyl than from carpet. Greater transfers from carpet were observed for an aerosol can formulation than for a broadcast formulation.

The observed mean standard deviation of the multiplier of hand press transfers obtained by the mechanical methods was 7.4 +/- 2.8 for the drag sled and 3.3 +/- 2.1 for the PUF roller (n = 17). Either mechanical method can be used to estimate dermal transfer of pesticide residues from recently treated floors.

Conclusions and Recommendations

Both the drag sled and the PUF roller were found to be acceptable dislodgeable residue methods on the basis of this study. Dermal transfer of pesticide residues can be estimated from transfers by the drag sled or PUF roller. Ratios which appear to apply to measurements on recently treated floors were obtained in this study. Round-robin testing of the drag sled and PUF roller is recommended under strict QA/QC guidance from EPA.

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Robert G. Lewis is the EPA Project Officer (see below).

The complete report, entitled "Comparison of Methods to Determine Dislodgeable Residue Transfer from Floors," (Order No. PB96-196712; Cost: \$28.00, subject to change) will be available only from:

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